Keywords: single-coil latching relay, relay memory, half bridge, full

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APPLICATION NOTE 4486

Single-coil latching relay drivers

Abstract: The schematics of Figure 1 illustrate five relay-driving circuits, depending on the input-signal logic levels, their coding, and the magnitude of available supply voltages. Because the single-coil latching relay has a memory of its own, its position after power up must be initialized to a known state, either by exercising the input logic or by analyzing and responding to a signal from the contacts circuitry.

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A single-coil latching relay is a relay with memory, usually with a magnetic structure that provides two stable positions for the armature that holds the movable contacts. The force holding the armature in these stable positions is provided by a permanent magnet. An application of electrical current to the relay coil moves the armature from one position to the other, which in turn changes the contact positions.

Applying to the coil a current pulse in one direction, of longer duration than the minimum specified for that relay type, sets the relay to the first of two stable positions, and it remains in that position after the current ceases to circulate. Current in the opposite direction resets the relay to the other position, which is also stable with no current. The relay then remains in that position indefinitely, until a new current pulse toggles it to the other position.

The electronic circuitry needed to drive one of these relays from logic signals can be a half bridge, if dual supply voltages are available, or a full bridge (an "H" type power driver) if only a single supply voltage is available. The use of these bridge topologies is imposed by the need to generate reversible current pulses through the 2-terminal coil. Because the relay itself does not consume power under static conditions, the driving circuitry should also consume minimal power under the same conditions.

The schematics of **Figure 1a-e** illustrate a variety of driving circuits, depending on the input-signal logic levels, their coding, and the magnitude of available supply voltages. Circuits (a) to (c) drive relays specified for voltages between 4 and 15 volts. Circuit (c) requires two separate control lines (SET sets the relay and RESET resets it). The set and reset signals can be coded as positive (active high) or negative (active low). You must use the same logic convention for both inputs in this circuit.

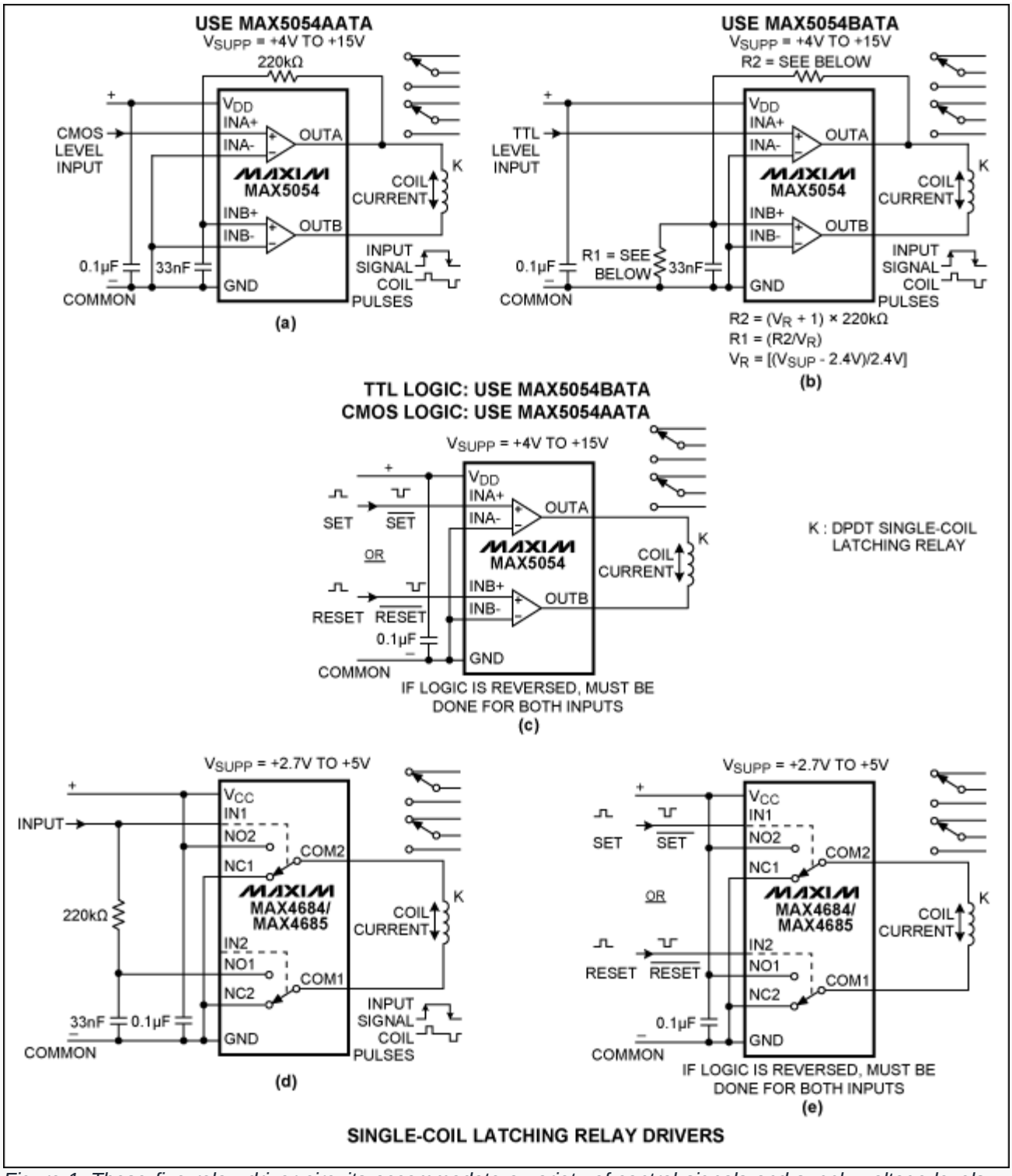

Figure 1. These five relay-driver circuits accommodate a variety of control signals and supply-voltage levels.

The widths of the SET and RESET signals must be longer than the minimum time required for the relay to operate (most relays require 3ms to 5ms). For proper operation, only one signal at a time should be applied; while one is applied, the other should remain at the non-active logic value. Using positive logic, for example, the signal must go high for 3ms to 5ms, and the other input must remain low until the first signal pulse has ended. The logic level required (TTL or power-supply-level CMOS) is defined by the choice of IC, as indicated in Figure 1c.

Circuits (a) and (b) operate from a single ON/OFF signal line, generating a coil-current pulse with each transition of the input signal. The polarity of the coil-current pulse depends on the polarity of the input signal transition that generates it (see input detail in Figure 1). Circuit (a) operates from CMOS logic levels and (b) from TTL levels. After each transition, the signal must remain stable for longer than the relay's minimum operating time. Circuits (a) and (c) draw quiescent currents of 40µA typical, and (b) about 50µA. Circuits (d) and (e) are similar to those above, but their supply-voltage range is 2.7V to 5.5V, and their maximum quiescent current is only 50nA.

Because the single-coil latching relay has a memory of its own (as mentioned earlier), its position after power up must be initialized to a known state, either by exercising the input logic or by analyzing and responding to a signal from the contacts circuitry. Any of these circuits ((a) through (d)) can deliver up to several hundred milliamps in either polarity while pulse-driving a relay coil. You can find technical information and data sheets for the ICs in these circuits at www.maxim-ic.com.

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